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IDAHO WATER RENTAL PILOT PROJECT PROBABILITY COORDINATION STUDY RESIDENT FISH AND WILDLIFE IMPACTS PHASE III

Annual Report 1997

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IDAHO WATER RENTAL PILOT PROJECT
PROBABILITY/COORDINATION STUDY
RESIDENT FISH AND WILDLIFE IMPACTS
PHASE III

ANNUAL REPORT

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EXECUTIVE SUMMARY

Phase III began in 1995 with the overall goal of quantifying changes in resident fish habitat in the Snake River Basin upstream of Brownlee Reservoir resulting from the release of salmon flow augmentation water. Existing data, in the form of weighted usable area versus flow relationships, were used to estimate habitat changes for white sturgeon (*Acipenser transmontanus*) and rainbow trout (*Oncorhynchus mykiss*)in the Snake River between C.J. Strike Dam and Brownlee pool. The increased flows resulted in increased habitat for adult and juvenile white sturgeon and adult rainbow trout. But, the flows have failed to meet mean monthly flow recommendations for the past three years despite the addition of the flow augmentation releases. It is unlikely that the flow augmentation releases have had any significant long-term benefit for sturgeon and rainbow trout in the Snake River. Flow augmentation releases from the Boise and Payette rivers have in some years helped to meet or exceed minimum flow recommendations in these tributaries. The minimum flows would not have been reached without the flow augmentation releases. But, in some instances, the timing of the releases need to be adjusted in order to maximize benefits to resident fishes in the Boise and Payette rivers.

INTRODUCTION

The use of stored Snake River water to aid anadromous fish migration in t Snake River downstream of Lewiston, Idaho, and in the Columbia River bega in 1982 with the adoption of the first Columbia Basin Fish and Wildlife Program (Program) by the Northwest Power Planning Council (NPPC). The Program called for a total of 1.19 million acre-feet (af) of water from t Snake River Basin to be delivered to Lower Granite Dam between April 15 a June 15 each year to aid spring outmigrating anadromous fish (NPPC 1982). This was called the water budget. This water would come primarily from Dworshak and Brownlee reservoirs.

The water budget evolved and became more specific in the NPPC’s Strategy for Salmon (NPPC 1992) in the use of Snake River water for flow augmentation. It called for a total of 427,000 af of water to come from the Snake River upstream of Brownlee Reservoir, up to 900,000 af from Dworshak Reservoir to aid spring migrants, and up to 200,000 af from Dworshak Reservoir to aid fall migrants. Then with the listing of Snake River salmon stocks on the endangered species list, the National Marine Fisheries Service (NMFS) in its Biological Opinion (NMFS 1995) on endangered Snake River salmon, replaced the water budget with flow target for the Snake and Columbia rivers while maintaining the requirement to us at least 427,000 af of upper Snake River Basin water for flow augmentatio In 1996, the Idaho Legislature approved the use of the 427,000 af on an experimental basis through the year 2000.

The Idaho Water Rental Pilot Project began in 1991 as part of the 1990 No Treaty Storage Fish and Wildlife Agreement (NTSFWA) between Bonneville Power Administration (BPA) and the Columbia Basin Fish and Wildlife Authority (CBFWA). This agreement resulted from concerns over potential impacts to fish and wildlife resulting from the Non-Treaty Storage Agreements (NTSA) signed between BPA and the mid-Columbia utilities, and between BPA and British Columbia Hydro and Power Authority. The NTSFWA contained several provisions designed to ensure the NTSA did not adversel impact fish and wildlife. One of the provisions called for identifying conditions needed for resident fish and wildlife and to protect those needs.

The Idaho Water Rental Pilot Project was designed to ✌identify resident fish and wildlife issues, concerns, and resources in the Snake River system, estimate impacts, and provide management recommendations to prote and enhance those resources✍ as impacted by the release of water in the upper Snake River Basin (upstream of Brownlee Reservoir) for enhancing juvenile salmon outmigration (Riggin and Hansen 1992). After the initial three years of the project, it was integrated into the NPPC■s Fish and Wildlife Program. The project was divided into these three phases:

1. Phase I focused on summarizing and identifying existing residen fish and wildlife resources, issues, and concerns as well as making flow recommendations (Riggin and Hansen 1992).

2. Phase II focused on conducting an Instream Flow Incremental Methodology (IFIM) study on the Snake River upstream of America Falls Dam and summarizing Snake River Basin water issues and fl augmentation releases since the completion of phase I (Stovall 1994).

3. Phase III is focusing on quantifying changes in resident fish habitat in the upper Snake River resulting from salmon flow augmentation releases and has these specific objectives:

   - Determine impacts to resident fish habitat (in weight usable area (WUA)) in the upper Snake River Basin, fo selected native fish species, resulting from salmon flow augmentation releases and make recommendations that will maximize benefits to reside native fish.

   - Develop a model that estimates changes in fish habita (WUA) in the upper Snake River resulting from salmon flow augmentation releases.

   - Coordinate with state, federal, and tribal agencies t ensure that duplication of effort does not occur in efforts to explore water management opportunities in the upper Snake River Basin for salmon flow augmentation.

STUDY AREA

The study area encompasses the Snake River upstream of Brownlee Pool to t Idaho border, the Henrys Fork, Boise River, and Payette River drainages. The flow augmentation water is physically moved from these Bureau of Reclamation (BOR) facilities within the study area: American Falls, Lucky Peak, Cascade, and Deadwood reservoirs (Figure 1).

METHODS

The analysis can be divided into two sections. The first is changes in fish habitat resulting from the flow augmentation releases. The second i a qualitative comparison of flows to minimum flow recommendations found i the literature.

Habitat

The same methods were used to estimate changes in fish habitat in the Sna River between C.J. Strike Dam and Brownlee Pool as was done previously (Leitzinger 1996). Data from the Swan Falls Instream Flow Study (SFIFS) (Anglin et al. 1992) was used to estimate changes in white sturgeon and rainbow trout habitat (weighted usable area) resulting from the release o salmon flow augmentation water from the Snake River Basin upstream of Brownlee Pool. The SFIFS divided the Snake River from C.J. Strike Dam to Brownlee Pool into five study reaches:

1. From C.J. Strike Dam downstream to Swan Falls Pool;
2. Swan Fall Dam downstream to Walters Ferry;
3. Walters Ferry downstream to the mouth of the Boise River;
4. The Boise River mouth downstream to the mouth of the Payette River;
5. The Payette River mouth downstream to Brownlee Pool.

The SFIFS developed habitat versus flow relationships for six species in each study reach: white sturgeon (*Acipenser transmontanus*), rainbow trout (*Oncorhynchus mykiss*), mountain whitefish (*Prosopium williamsoni*), smallmouth bass (*Micropterus dolomieui*), flathead catfish (*Pylodictis olivaris*), and channel catfish (*Ictalurus punctatus*). The analysis used this report covered the same five study reaches. White sturgeon and rainb trout were used in this analysis because they are the primary native game species left in that reach of the basin. Total WUA was expressed in millions of square feet in each reach.

The Idaho Department of Fish and Game, in cooperation with the Idaho Department of Water Resources (IDWR) and BOR conducted minimum flow studi on much of the Snake River in the 1970s and 1980s using the wetted perimeter method (White and Cochnauer 1975; Cochnauer 1976, 1977; Cochnau and Buettner 1978; Cochnauer and Hoyt 1979; Horton and Cochnauer 1980; Cochnauer and Mabbott 1981). These data were not used because the method is a standard setting method used to define minimum flows. It is based o the assumption that if minimum flows over narrow riffles are adequate for food production, passage, and spawning, then all other habitats will be adequately protected as well (Stalnaker et al. 1994). The wetted perimet is an indirect measure of habitat and thus could not be used to quantify habitat changes resulting from increased flow.

Data tracking the movement of the flow augmentation water from the upper Snake River Basin were collected and summarized from the BOR and IDWR. O problem with these data is that the agencies' tracking of the data is incomplete from a biological perspective. IDWR has detailed information the water including days, volumes, flow rates, etc., but it is only monitored at three locations in the upper Snake River Basin. These locations are Milner Dam on the main Snake River, Letha Bridge on the low Payette River, and the Middleton Gage on the lower Boise River. The Murp Gage, downstream from Swan Falls Dam, would be an excellent location to account for and demonstrate impacts of the flow augmentation water in the lower Snake River. Unfortunately, it is not being used for this purpose a this time (B. Ondrechen, IDWR personal communication). The BOR data, on the other hand, give the total volumes released from each reservoir but d not give when it was released nor the resulting flows. The major proble with tracking the flow augmentation water has been the difference between the accounting of the water and the actual physical movement of water through the system. On paper, the data from the BOR and IDWR show the water is being moved out of various reservoirs at various times of the year. The reality, however, is that the water is physically moved only o of American Falls Reservoir in the upper Snake River Basin, Lucky Peak Reservoir in the Boise River Basin, and Cascade and Deadwood reservoirs i the Payette River Basin (R. Larson and R. Rigby BOR personal communicatio while other reservoir storage accounts are charged with the flow augmentation releases. For example, individuals that own storage rights any of the reservoirs upstream of Milner Dam (water district 01) may put some of their stored water into the district's rental pool. If the BOR purchases water from the rental pool, it will physically be moved out of American Falls Reservoir even though the storage right may have been from someplace else. The accounting of the water will be charged to the reservoirs where the storage right exists. Also, small amounts have been charged to uncontracted space. The storage reservoirs within a water district are operated as a single system, not independent reservoirs. Th are operated in a way that tries to maximize the operational flexibility the system. To do this, the reservoirs are prioritized as to which get drawn down first and which maintain as much water as possible for as long as possible. Generally, the BOR strives to keep water as high in the system as possible. Water can always be moved down the system, but not back up. In order to maintain flexibility, it is quite common for storage space to be transferred among reservoirs. So, it is possible to have Anderson Ranch Reservoir storage space in Lucky Peak Reservoir and vice versa. The main concern BOR has is meeting the total demand for water at the control points (i.e. Milner Dam on the Snake, Letha gage on the Payette, and the Middleton gage on the Boise River). If conditions are such that American Falls Reservoir will refill without having to physical move this water, then it will not be moved. American Falls Reservoir usually refills even in low water years due to the large inflow of spring in the area. The only time the water will be physically moved from a reservoir other than American Falls Reservoir in the upper Snake River Basin is during a very low water year when there is not enough water in American Falls Reservoir (R. Larson BOR personal communication). The sam holds true for the Boise system. If natural flows are sufficient to refi Lucky Peak Reservoir storage space used for flow augmentation, then the uncontracted storage in Anderson Ranch Reservoir will not be physically moved out of the reservoir even though on paper it appears as though it has.

A Lotus spreadsheet was developed that calculates the change in WUA expressed in millions of square feet in each reach the same ages classes sturgeon and rainbow trout used in the SFIFS. The sturgeon life stages were: adult, larvae, spawning, and incubation. The age classes for rainb trout were adult, juvenile, spawning, and fry. The spreadsheet took Unit States Geological Survey (USGS) daily stream gage data and subtracted the flow augmentation releases from IDWR. The resulting values represented what the flow in the river would have been without the flow augmentation releases. The stream gage data represents the flow in the river with the flow augmentation water. Then using the SFIFS data, WUA was calculated f each flow. These values were subtracted to get the change in WUA resulti from the flow augmentation releases. The SFIFS habitat versus flow curve were developed using flows from 5,000 to 17,000 cubic feet per second (cf in 1,000 cfs increments (5,000, 6,000, 7,000, etc.). Actual flows were somewhere between these points, so WUA for the actual flows were estimate by linear interpolation between the two closest increments. If the actua flow was 6,500 cfs, the WUA was calculated to be half-way between the WUA at 6,000 and 7,000 cfs. If the actual flow was 8,900 cfs, the WUA was estimated to be 90% of the difference between the WUA at 8,000 and 9,000 cfs. This analysis was done for the 1996 flow augmentation releases by month. Habitat changes were summarized for each month the flow augmentation water was released.

The data from IDWR give the dates the flow augmentation water passes the three control points (Milner Dam on the Snake River, Letha Bridge on the Payette River, and the USGS gage on the Boise River near Middleton) and t dates the water reaches Brownlee Pool. From this it was possible to determine the number of days it took the water to travel from the control points to Brownlee Pool. It was assumed that the water traveled an equal distance each day in order to estimate when the water reached each of the five study reaches between C.J. Strike Dam and Brownlee Pool.

Flows

Flows in the Boise River, Payette River, and Snake River, with and withou the flow augmentation water were compared to flow recommendations from th literature to see if flows were being met and if the augmentation water helped achieve those flows.

RESULTS AND DISCUSSION

Habitat

Flow augmentation releases for 1996 are summarized in Tables 1 and 2. Although the total volume released was slightly less than in 1995, the timing and duration of the releases, the reservoirs used, and volumes fro each reservoir were similar. The Payette release was split 50/50 between summer and winter releases. This was done in an attempt to balance the fish and water quality needs in Cascade Reservoir and those in the river downstream. Winter has been identified as a critical period for salmonid in the Payette River system. It is thought to be the time when additiona flows would benefit the fishery the most (Riggin and Hansen 1992). The volume released in the Boise system increased by 11,000 af over 1995. Thi increase was due to the purchase of 35,000 af of storage space from Nampa Meridian Irrigation District by the BOR. This and other water purchases will help stabilize and increase the predictability of the salmon flow augmentation releases.

Table 3 lists flow releases since 1987. The flows from the upper Snake River were less than 200,000 af prior to 1993. The release of approximately 427,000 af has occurred only the last four years.

Tables 4-13 summarize the changes in fish habitat for white sturgeon and rainbow trout in the five study reaches in the Snake River from C.J. Stri Dam to Brownlee Pool for 1996. Anglin et al. (1992) summarized the spawning, incubation, larval, and adult/juvenile time periods for each species in each of the five sections. Those for white sturgeon and rainb trout are listed in Table 14. Much of the sturgeon information has been taken from recent work done by Idaho Power Company (Lepla and Chandler 1995). Habitat changes were estimated only for adult and juvenile white sturgeon and adult, juvenile, and fry rainbow trout. These were the only life stages present during the flow augmentation releases.

In all cases the increased flows resulted in increased habitat for adult and juvenile white sturgeon (Tables 4-8). The increases in adult/juvenil white sturgeon habitat (in terms of square feet gained) ranged from a low of 140,000 sf in the Swan Falls Dam to Walters Ferry reach during Septemb to 7,480,000 sf in the Boise River mouth to Payette River mouth reach during July.

Lepla and Chandler (1995) identified sturgeon in the middle Snake River a habitat generalists, using a wide variety of habitats. Physical habitat variables (depth, velocity, and substrate) accounted for only 28% of the variability in sturgeon location. Lepla and Chandler (1995) suggested other factors such as prey abundance and availability may be more importa than physical habitat in determining the distribution of white sturgeon i the middle Snake River. This concurs with other work in the Columbia Riv (Parsley and Beckman 1992). So, increases in sturgeon habitat may not result in any benefit to the sturgeon population especially if the change are short term and do not benefit a critical or limited life stage (e.g. spawning and larvae) or a limiting time period. The spring sturgeon spawning and larval development period has been identified as a critical time period for sturgeon (D. Parrish, IDFG personal communication) in the reach from upper Salmon Falls Dam to C. J. Strike Reservoir. Often, there are insufficient flows and water temperatures are too warm for successful sturgeon spawning and larval development. But, summer flows have also be identified as a critical period for sturgeon in the stretch of the river from C. J. Strike Dam to Brownlee Pool. Flows in this stretch of the riv during the summer are often almost stagnant and suffer from extreme nutrient loading (S. Grunder IDFG personal communication). This results very low dissolved oxygen levels and even fish kills. Riggin and Hansen (1992) recommended releasing the flow augmentation water from July 1 to September 30 to benefit water quality in this reach of the Snake River. But, water quality benefits are thought to be minimal at best due to this release strategy because the flow augmentation water is warm water releas from American Falls Reservoir and it is split at Milner Dam (D. Parrish, IDFG personal communication). At present only 200 cfs flows in the river channel and the remaining (approximately 1,300 cfs) water is diverted though an irrigation canal for a little over a mile so it can run through turbine before it is returned to the river. Thus, the water is subject to increased warming and nutrient loading compared to keeping all the water the river channel. Obviously, the flow augmentation water can not solve all these problems, but it can help. One option might be to release the water in the spring (April through June) for sturgeon spawning and larval development in dry years and release it starting in June in normal and we years to protect larval sturgeon and for improved water quality.

Interpretation of the rainbow trout results is not as straight forward as the sturgeon. The results are summarized in Tables 9-13. Habitat increased for adult rainbow trout in all sections except for July in the Payette River mouth to Brownlee Pool reach. Adult habitat was reduced by only 270,000 sf (0.21%). The increases in habitat ranged from 750,000 sf in the Swan Falls to Walters Ferry reach during September to 30,200,000 s in the Walters Ferry to Boise River mouth reach during July.

In the majority of cases, the flow augmentation releases appear to result in losses of juvenile and fry rainbow trout habitat. There was only one section that showed an increase in juvenile rainbow trout habitat. The increase was minor - only 150,000 sf in the Swan Falls to Walters Ferry reach during July. Juvenile habitat losses ranged from 50,000 sf in the Swan Falls Dam to Walters Ferry reach during August to 15,480,000 sf in t Walters Ferry to Boise River mouth reach during July. Fry habitat decreased in all reaches of the Snake River. Fry habitat losses ranged from 100,000 sf in the Payette River mouth to Brownlee Pool reach during July to 16,270,000 sf in the Walters Ferry to Boise River mouth reach during July.

These habitat losses are not significant for two reasons. First, it is very unlikely that rainbow trout fry and juveniles used the mainstem Snak River extensively. As with most large rivers, the native rainbows probab had a fluvial life history, meaning the majority of spawning and early rearing occurred in the tributaries, while the adults and larger juvenile reared in the mainstem Snake River. Unfortunately, there is very little documented life history information on native rainbow trout in this reach of the Snake River. The only evidence found came from Irving and Cuplin (1956). They sampled this reach of the Snake River in 1953 and 1954 and the smallest wild rainbow trout caught were eight inches long.

Second, it is extremely difficult to sample large rivers for juvenile and fry life stages, especially at high flow. Because of this, the suitabili index (SI) curves used for rainbow trout were not site specific. They we taken from the literature (Raleigh et al. 1984). These curves were developed on small, clear trout streams in Colorado. This calls into question the appropriateness of using these SI curves. Because they were developed for small streams, the preference or use of the habitat (as expressed by depth, velocity, cover, and temperature) will undoubtedly be narrow, especially when compared to the broader range of habitat that wou be expected in a larger river. These fish may use a greater range of habitat in a larger river simply because it is available. Thus, using SI curves developed for small streams may result in an artificially reduced restricted estimate of available habitat when applied to large rivers.

This analysis also raises several questions. Does a short-term (three to five month) increase in flows provide any long-term benefits to resident fish habitat and thus resident fish? When are the flow (or habitat) bottlenecks for sturgeon and rainbow trout (or other resident fish specie in this section of the Snake River? If they are not during the summer, then does this water have any long-term benefit to resident fish? If the is a summer flow bottleneck once these flows are reduced to base flow in the fall, are the benefits then lost because the flow bottleneck has just been delayed to later in the year? These questions are beyond the scope of this project but need to be addressed if this water is to benefit resident fish.

Flows

The flow recommendations in the SFIFS (Anglin et al. 1992) are summarized in Table 15. It is interesting to note that actual mean monthly flows fr 1994 through 1996 (including the flow augmentation water) never met the integrated fish flow recommendations (the target or preferred fish flows) or the recommended flows for wet years. They were at best 2,000 cfs belo the integrated fish flows. Even during the wet years of 1995 and 1996, t flows in six of the seven months exceeded just the dry year flow recommendation. One month did not even meet the dry year recommendation. Overall, these enhanced flows never met the integrated fish flows or the wet year recommendations over the past three years. The average water ye recommendation was met in only one of the 12 months of flow augmentation over the past three years. The dry year recommendation was met in only eight of the 12 months. Clearly, although the additional flow provided b the flow augmentation water provides benefits to resident fish habitat (primarily adult and juvenile sturgeon and adult rainbow trout), it is no enough to avoid further degradation of sturgeon and rainbow trout habitat because Anglin et al. (1992) defined these minimum flows as that which would prevent ✌further degradation of resident fish habitat✍. At best these additional flows would only slow down the rate of decline of these fish populations.

The comparisons of the actual enhanced flows (i.e. with the salmon flow augmentation water) to the minimum stream flow recommendations for the tributaries and the Snake River are summarized in Table 16. The enhanced flows in the Boise River met or exceeded the minimum flow recommendation all the time on a mean monthly basis. The recommended monthly flows woul have been met only 50% of the time without the flow augmentation water (three of the six months over the last three years). It needs to be pointed out that this water is released during the summer, when flows are not assumed to be limiting. It also needs to be pointed out that these a **minimum flows**, not preferred or ideal flows. Traditionally minimum flows have been considered short- term, essential flows that prevent collapse o the fishery, and have become targets to reach some of the time.

The nonirrigation season (roughly from mid-October to mid-April) has been identified as the period when additional water would most benefit the salmonid fishery in the Boise River downstream of Lucky Peak Dam (Riggin and Hansen 1992; D. Allen, IDFG, personal communication). Analysis of th USGS gaging station records (Brennan et al. 1996) support this. Mean monthly predevelopment winter flows (October - February, 1895 -1916) in t Boise River below Moores Creek ranged from 969 to 1,299 cfs and minimum monthly flows for the same time period ranged from 509 - 925 cfs. Post development (1955 - 1996) mean monthly flows ranged from 205 - 924 cfs while mean minimum flows ranged from 0 -63 cfs. It is clear that the greatest change in the flow regime in the Boise River has been the reduction of nonirrigation season flows. Shifting the flow augmentation release from the summer to the winter in addition to the stream channel maintenance flows presently being released would go a long way toward returning to historic winter flows and a normative hydrograph. The resultant flows would be in the neighborhood of 500 - 600 cfs. While the flows are similar to the historic minimum monthly flows, they are a vast improvement on the 150 - 240 cfs currently being released for stream channel maintenance in the nonirrigation season. But, they are well belo the historic mean monthly flows.

The summer releases in the Payette system (1994 and 1996) met the mean monthly minimum flow recommendations only 25% of the time (one out of fou months) at the Letha gage. Minimum flows would not have been met during that one month if the flow augmentation water was not released. Minimum flow recommendations were met 50% of the time (two of four months) at the Cascade gage. It is impossible to determine how much of an impact the fl augmentation releases had because it is impossible to separate out the Cascade and Deadwood releases. The total flow augmentation release is measured only at the Letha gage, well downstream of each dam.

The winter releases in the Payette all came out of Cascade Reservoir. Me monthly minimum flows were met all the time during the winter of 1995/96 below Cascade Reservoir and at Letha. However, the flow recommendations would not have been met below Cascade without the flow augmentation releases. They would have been met at Letha without the additional water Mean monthly flows below Cascade Reservoir and at Letha during the winte of 1996/97 met minimums all the time. But, these flows would have been m even without the flow augmentation releases due to unusually high water during that time period.

CONCLUSIONS AND RECOMMENDATIONS

The additional water provided by the salmon flow augmentation releases appears to have, at best, limited benefits to resident fish and fish habitat. Although usable habitat increased in the Snake River for adult and juvenile sturgeon and adult rainbow trout, the flows were still well below what is needed to sustain viable healthy fish populations. Flow augmentation in the tributaries sometimes helped meet minimum flows, sometimes the flows would have been met even without the additional water and other times the flows were not met even with the extra water. Obviously, other factors are influencing flows more than the salmon flow releases (e.g. weather and precipitation). Further monitoring and evaluation is needed in order to gain a better understanding of the impac these flow releases in the tributaries (primarily the Payette system) are having on resident fish.

It is clear that changes are needed if water management in the Snake Rive Basin is to take into account the needs of the fishery resources. If wat quality is to be improved and sturgeon populations are to be recovered to healthy, viable level, then more water is needed at the proper times (namely spring for spawning sturgeon and larval sturgeon development and the summer to improve water quality and prevent fish kills). Salmon flow releases are not sufficient to do it alone. Modification of existing flo augmentation releases in the tributaries could go a long way to improving conditions for fish. The following recommendations are presented in an effort to refine the salmon flow augmentation releases to maximize benefi to resident fish.

1) Release the salmon flow augmentation water out of Lucky Peak Reservo on the Boise River during the nonirrigation season (mid-October - mi April) in addition to the stream channel maintenance flows presently

being released. These flows will significantly help keep fry and juvenile trout habitat under water and available during the nonirrigation season. The resulting flows would be similar to the historic minimum monthly flows observed prior to any dam constructio

2) Continue the 50/50 summer/winter release in the Payette River Basin. This strategy may have benefits to resident fish, but no clear trend is evident. Hopefully, future monitoring will show clear benefits. This strategy is consistent with previous recommendations.

3) The BOR and IDWR should monitor flow augmentation releases from Cascade and Deadwood reservoirs separately. This would allow a much more detailed evaluation of the impact of these flows in the Deadwoo South Fork and North Fork Payette rivers.

4) Discontinue the splitting of the salmon flow releases in the upper Snake River at Milner Dam. Keep the entire 1,500 cfs in the river channel. Current operation is to only send 200 cfs down the river, while the remaining water (approximately 1,300 cfs) gets sent down a irrigation canal for a little over a mile so that it can be sent through turbines before returning to the river. This splitting of th water may negate any water quality benefits this extra water could provide. The 200 cfs left in the river is subject to intense solar radiation and thus excessive warming. The remaining water is also subject to warming as well as additional nutrient loading from agricultural fields the canals irrigate.

5) Conduct IFIM studies below BOR facilities so that changes in fish habitat resulting from the release of the salmon flow augmentation water can be quantified.

6) In dry years, release the water from American Falls Reservoir in the spring (April - June) to aid sturgeon spawning and larval developmen In normal to wet years, begin releasing the water in June to keep t water temperatures cooler to protect sturgeon larvae and to improve water quality.

There are not enough IFIM data in the Snake River Basin to estimate resident fish habitat changes resulting from this flow augmentation water in most of the basin. Even where the data exist, quantification of habit changes are further complicated by the water accounting system establishe by the BOR and IDWR. The present system is inadequate for describing whe the water is released, the source reservoir for the water, and at what daily rate (in cfs) the water is released, especially in the Snake River upstream of Milner Dam. Until a more detailed method for tracking and recording flow augmentation water is developed, quantifying impacts to resident fish habitat will be very limited.

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Table 1. Stored water provided for salmon flow augmentation from Bureau Reclamation reservoirs in acre-feet, 1996 (data from Bureau of Reclamation and IDWR).

SYSTEM/ RESERVOIR	Reclamation Power Head	Space Uncontracted	Rental Pool	Total
Upper Snake*				
American Falls		8,951		
Jackson		3,923		
Palisades		9,522		
Subtotal		22,396	194,667	217,063
Payette**				
Cascade		69,600		
Deadwood		25,400		
Subtotal		95,000	56,300	151,300
Boise***				
Anderson Ranch		3,000		
Lucky Peak		35,000		
Subtotal		38,000		38,000
Oregon				
Skyline Farms			15,714	
Or. Water Trust			64	
Subtotal			15,778	15,778
GRAND TOTAL		155,896	266,745	422,141

* All water was physically moved out of American Falls Reservoir, but storage accounts in the other reservoirs were charged.

** The Payette release was split roughly 50/50 between summer and winte releases. The summer releases were both Cascade and Deadwood storag The winter release was exclusively Cascade release. A total of 75,167 acre-feet was released in the summer, 76,133 acre-feet was released in the winter. The rental pool water was released from Cascade Reservoir.

*** All water was physically moved out of Lucky Peak Reservoir but 3,000 acre-feet were charged to the Anderson Ranch account.

Table 2. Timing of the 1996 flow augmentation releases from the upper Snake Basin.

System	**Source/Space**	**Start Date**	**End Date**	**Location of measured flow**
Upper Snake*	Rental Pool Uncontracted	7/4/96 8/31/96	8/31/96 9/14/96	Milner Dam
Boise**	Lucky Peak Anderson Ranch	7/11/96 8/24/96	8/24/96 8/29/96	Middleton Gage
Payette***	Summer Release Winter Release	7/12/96 12/11/96	9/2/96 2/8/97	Letha Gage Letha Gage
Skyline Farms	Irrigation Purchase	5/31/96	8/31/96	

* This water was actually released from American Falls Reservoir but t start and end dates reflect the dates the water flowed past Milner D (source: IDWR).

** The Boise River release came from a purchase of 35,000 acre-feet of storage in Lucky Peak Reservoir, and uncontracted storage from Anderson Ranch Reservoir.

*** The Payette River release was split roughly 50/50 between summer and winter release. The winter release came exclusively from Cascade Reservoir.

Table 3. Water provided for flow augmentation from the Snake River Basin upstream of Hells Canyon Dam, 1987-1995. Values are in acre-feet.

System	1987	1988	1989	1990	1991	1992	1993	1994	1995	199
Upper Snake										
USBR Space	0	0	0	0	0	0	206,617	285,954	22,396	2
Rentals	150,000	50,000	100,000	63,000	0	0	65,000	44,325	232,839	19
BPA Purchase	0	0	0	0	50,000	49,000	0	0	0	
Subtotal	150,000	50,000	100,000	63,000	50,000	49,000	271,617	330,279	255,235	21
Payette										
USBR Space	0	0	0	0	0	90,000	95,000	61,883	94,242	9
Rentals	0	0	0	0	0	0	34,971	0	50,758	5
BPA Purchase	0	0	0	0	51,000	51,000	0	0	0	
Subtotal	0	0	0	0	51,000	141,000	129,971	61,883	145,000	15
Boise										
USBR Space	0	0	0	0	0	0	23,000	35,950	25,000	3
Rentals	0	0	0	0	0	0	0	0	2,000	
Subtotal	0	0	0	0	0	0	23,000	35,950	27,000	3
Natural Flows										
Skyline Farms	0	0	0	0	0	0	0	0	0	1
OR Water Trust	0	0	0	0	0	0	0	0	0	
Subtotal	0	0	0	0	0	0	0	0	0	1
Upper Snake Contribution	150,000	50,000	100,000	63,000	101,000	190,000	424,588	428,112	427,235	42
Brownlee	0	0	50,000	87,000	174,000	110,000	102,000	326,270	235,000	29
Grand Total	150,000	50,000	150,000	150,000	275,000	300,000	526,588	754,382	662,235	72

Table 4. Changes in white sturgeon habitat in the Snake River from C.J. Strike Dam to Swan Falls Pool resulting from salmon flow augmentation releases during the summer of 1996. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa

feet

				Total Flow				Net Flow			
Change											
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	Incub
July 7/7-7/31	7,705	1,835	5,870	23.24	16.89	5.50	15.02	20.29	16.07	3.16	12.24
Aug. 8/1-8/31	7,912	1,543	6,369	23.55	16.92	5.77	15.32	21.14	16.42	3.77	13.05
Sept. 9/1-9/17	7,996	940	7,056	23.67	16.93	5.88	15.43	22.26	16.81	4.63	14.10

Table 5. Changes in white sturgeon habitat in the Snake River from Swan Falls Dam to Walter Ferry resulting from salmon flow augmentation releases during the summer of 1996. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa

feet

				Total Flow				Net Flow			
Change											
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	In
July 7/8-7/31	7,466	1,847	5,619	3.91	2.51	1.88	3.06	3.58	2.73	1.29	2
Aug. 8/1-	7,765	1,543	6,222	3.95	2.47	1.96	3.11	3.70	2.68	1.49	2

8/31											
Sept. 9/1- 9/18	7,927	974	6,953	3.97	2.44	2.01	3.14	3.83	2.59	1.73	2

Table 6. Changes in white sturgeon habitat in the Snake River from Walters Ferry to the Boi River resulting from salmon flow augmentation releases during the summer of 1996. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa feet

				Total Flow				Net Flow			Change
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	I
July 7/8- 7/31	7,466	1,847	5,619	40.14	35.14	3.41	10.52	32.79	30.35	1.74	
Aug. 8/1- 8/31	7,765	1,543	6,222	41.27	35.77	3.71	11.02	35.26	32.10	2.23	
Sept. 9/1- 9/18	7,927	974	6,953	41.88	36.12	3.87	11.29	38.19	34.04	2.91	

Table 7. Changes in white sturgeon habitat in the Snake River from the Boise River to the Payette River resulting from salmon flow augmentation releases during the summer o 1996. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa feet

				Total Flow				Net Flow			Change
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	I
July 7/9- 7/31	9,237	2,176	7,061	46.04	35.30	3.04	12.29	38.57	32.55	1.28	8
Aug. 8/1- 8/31	9,694	1,934	7,760	47.31	35.67	3.45	12.84	41.15	33.61	1.80	
Sept.	9,924	1,004	8,920	47.94	35.86	3.66	13.12	45.12	35.02	2.75	1

9/1- 9/19												

Table 8. Changes in white sturgeon habitat in the Snake River from the Payette River to Brownlee Pool resulting from salmon flow augmentation releases during the summer o 1996. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa feet

		Change		Total Flow				Net Flow			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	I
July 7/1-7/9	16,444	110	16,334	48.00	28.01	14.81	23.75	47.99	28.11	14.68	2
July 7/10-7/31	12,059	3,004	9,055	45.40	30.42	9.38	19.63	40.23	29.78	5.80	1
Aug. 8/1-8/31	11,710	2,759	8,951	44.93	30.40	8.97	19.17	39.99	29.73	5.67	1
Sept. 9/1-9/20	11,960	1,058	10,902	45.28	30.43	9.26	19.51	43.80	30.30	8.01	1

Table 9. Changes in rainbow trout habitat in the Snake River from C.J. Strike Dam to Swan Falls Pool resulting from salmon flow augmentation releases during the summer of 1996. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa
feet

		Change		Total Flow				Net Flow			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	F
July 7/7-7/31	7,705	1,835	5,870	43.99	15.72	2.96	7.04	41.80	17.93	2.51	7
Aug. 8/1-8/31	7,912	1,543	6,369	44.17	15.51	3.08	7.01	42.59	17.25	2.53	7
Sept. 9/1-9/17	7,996	940	7,056	44.24	15.42	3.13	7.00	43.45	16.36	2.59	7

Table 10. Changes in rainbow trout habitat in the Snake River from Swan Falls Dam to Walters Ferry resulting from salmon flow augmentation releases during the summer of 1996. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa
feet

Change

				Total Flow				Net Flow			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry
July 7/8-7/31	7,466	1,847	5,619	8.22	6.40	0.36	2.64	6.39	6.25	0.48	3.38
Aug. 8/1-8/31	7,765	1,543	6,222	8.45	6.37	0.37	2.46	7.09	6.42	0.45	3.18
Sept. 9/1-9/18	7,927	974	6,953	8.57	6.35	0.38	2.36	7.82	6.46	0.35	2.94

Table 11. Changes in rainbow trout habitat in the Snake River from Walters Ferry to the Bois River resulting from salmon flow augmentation releases during the summer of 1996. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa feet

		Change		Total Flow				Net Flow			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	
July 7/8-7/31	7,466	1,847	5,619	228.08	81.36	96.06	35.45	197.89	96.84	74.13	5
Aug. 8/1-8/31	7,765	1,543	6,222	231.65	78.39	99.88	32.63	208.32	92.40	79.18	4
Sept. 9/1-9/18	7,927	974	6,953	233.58	76.78	101.96	31.10	221.67	86.37	89.44	4

Table 12. Changes in rainbow trout habitat in the Snake River from the Boise River to the Payette River resulting from salmon flow augmentation releases during the summer o 1996. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa feet

				Total Flow				Net Flow		
Change										
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn
July 7/9-7/31	9,237	2,176	7,061	231.54	65.21	80.49	28.28	211.58	74.74	73.39
Aug. 8/1-8/31	9,694	1,934	7,760	232.48	62.90	78.83	26.51	220.71	72.29	76.78
Sept. 9/1-9/19	9,924	1,004	8,920	232.95	61.74	78.00	25.62	230.47	66.80	81.08

Table 13. Changes in rainbow trout habitat in the Snake River from the Payette River to Brownlee Pool resulting from salmon flow augmentation releases during the summer o 1996. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of squa feet

				Total Flow				Net Flow		
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn
July 7/1-7/9	16,444	110	16,334	125.87	34.14	42.04	8.82	126.14	34.38	42.22
July 7/10-7/31	12,059	3,004	9,055	131.52	47.35	37.72	14.62	125.05	61.61	26.94
Aug. 8/1-8/31	11,710	2,759	8,951	131.07	48.98	36.39	15.59	124.57	62.04	26.48
Sept. 9/1-9/20	11,960	1,058	10,902	131.45	47.79	37.36	14.85	129.85	52.81	33.34

Change

Table 14. White sturgeon and Rainbow trout life stages and time of occurrence in the Snake River (from Anglin et al. 1992 and Lepla and Chandler 1995). Incub.= incubation; Juven.= juvenile.

Species/ Life Stage	C.J. Strike to Swan Falls	Swan Falls to Walters Ferry	Walters Ferry to Boise River	Boise River to Payette River	Payette River to Brownlee Pool
Sturgeon Spawning	April-May (2 months)	April-May (2 months)	April-May (2 months)	April-May (2 months)	April-May (2 months)
Sturgeon Larvae	April-June (3 months)	April-June (3 months)	April-June (3 months)	April-June (3 months)	April-June (3 months)
Sturgeon Incub.	April-May (2 months)	April-May (2 months)	April-May (2 months)	April-May (2 months)	April-May (2 months)
Sturgeon Adult/Juven	all year	all year	all year	all year	all year
Rainbow Trout Spawning	March-April (2 months)	March-April (2 months)	March-April (2 months)	March-April (2 months)	March-April (2 months)
Rainbow Trout Fry	April-Sept. (6 months)	April-Sept. (6 months)	April-Sept. (6 months)	April-Sept. (6 months)	April-Sept. (6 months)
Rainbow Trout Juvenile	all year	all year	all year	all year	all year
Rainbow Trout Adult	all year	all year	all year	all year	all year

Table 15. Integrated (target) fish flows and recommended minimum stream flows by month for average, wet and dry years, and actual flows recorded at the Murphy Gage on the Snake River downstream of Sw Falls Dam during the flow augmentation period in 1994, 1995, an 1996. The integrated and recommended minimum flows are also fo the Murphy Gage. Data is from Anglin et al. (1992). Flows are in cubic feet per second.

Flow	April	May	June	July	August	Sept
Integrated Fish Flow	15,000	12,500	9,000	12,500	12,500	12,
Recommended Minimum Flow						
Average Year	13,600	12,500	9,000	8,100	7,500	8,
Wet Year (20% exceedence)	15,000	12,500	9,000	8,800	8,100	9,
Dry Year (80% exceedence)	8,400	7,400	7,300	6,500	6,700	7,
Actual Flows						
1994	7,947	8,341	7,004	6,565	6,225	-
1995	--	--	--	7,941	7,400	8,
1996	--	--	--	7,466	7,765	7,

Table 16. Flow summary for years 1994 - 1996 showing the salmon flow augmentation release dates, total mean monthly flows, flow augmentation component of total flow, minimum flow recommendations, frequency that flows met or exceeded minimums, and recommended release time.

RIVER	YEAR	LOCATION (USGS GAGE)	FLOW AUGMENT. PERIOD	TOTAL FLOW MEAN MONTHLY (CFS)	MEAN AUGMENT. FLOW (CFS)	MAXIMUM FLOW (CFS)	MINIMUM FLOW (CFS)	FLOW RECC (CFS)
Boise	1994	Middleton	7/5-7/31 8/1-8/19	557 481	410 371	601 525	293 343	240 240
	1995	Middleton	7/17-7/31 8/1-8/20	775 622	400 381	1,060 772	699 403	240 240
	1996	Middleton	7/11-7/31 8/1-8/29	610 632	386 390	705 702	572 564	240 240
Payette	1994	Cascade*	7/1-7/31 8/1-8/15	1,778 1,576	? ?	1,940 1,920	1,140 1,350	1,400 1,400
	1994	Letha	7/2-7/31 8/1-8/16	911 560	825 430	1,350 986	340 310	1,165 1,165
	1995/ 1996	Cascade	11/30-12/31 1/1-1/15	1,748 2,078	1,471 1,830	2,230 2,200	475 1,720	400 400

Table 16. Cont■d.

RIVER	YEAR	LOCATION (USGS GAGE)	FLOW AUGMENT. PERIOD	TOTAL FLOW MEAN MONTHLY (CFS)	MEAN AUGMENT. FLOW (CFS)	MAXIMUM FLOW (CFS)	MINIMUM FLOW (CFS)	FLOW RECC (CFS)
	1995/ 1996	Letha	12/1-12/31 1/1-1/16	4,185 3,738	1,456 1,837	8,000 4,370	2,450 3,140	1,165 1,165

	1996	Cascade*	7/11-7/31 8/1-9/1	1,248 1,343	? ?	1,460 1,410	1,060 1,300	1,400 1,400
	1996	Letha	7/12-7/31 8/1-9/2	1,525 816	778 677	2,320 1,260	1,170 230	1,165 1,165
	1996/ 1997	Cascade**	12/11-12/31 1/1-1/31 2/1-2/8	1,651 2,749 2,168	522 1,758 1,629	1,988 3,853 3,761	1,477 217 203	400 400 400
	1996/ 1997	Letha**	12/12-12/31 1/1-1/31 2/1-2/9	4,838 7,547 6,249	548 1,758 1,448	12,277 18,030 7,766	2,899 5,179 4,325	1,165 1,165 1,165

Table 16. Cont'd.

RIVER	YEAR	LOCATION (USGS GAGE)	FLOW AUGMENT. PERIOD	TOTAL FLOW MEAN MONTHLY (CFS)	MEAN AUGMENT. FLOW (CFS)	MAXIMUM FLOW (CFS)	MINIMUM FLOW (CFS)	FLOW RECC (CFS)
Snake	1994	Murphy	4/17-4/30 5/1-5/31 6/1-6/30 7/1-7/31 8/1-8/20	7,947 8,341 7,004 6,565 6,225	1,360 1,309 1,465 1,515 954	9,720 9,490 9,020 8,180 6,950	7,150 6,890 5,750 5,490 5,370	15,000 12,500 9,000 12,500 12,500
	1995	Murphy	7/6-7/31 8/1-8/31 9/1-9/30 10/1-10/3	7,941 7,400 8,413 7,930	1,491 1,553 1,361 316	9,440 8,080 9,160 8,140	6,240 6,860 7,370 7,770	12,500 12,500 12,500 12,500
	1996	Murphy	7/8-7/31 8/1-8/31	7,466 7,765	1,847 1,543	8,420 8,490	6,500 6,980	12,500 12,500

			9/1-9/18	7,927	974	9,030	7,130	12,500

* = Flow augmentation component could not be determined. Augmentation releases from Cascade and Deadwood reservoirs were not recorded separately.

** = Provisional data, not finalized, subject to change.